Editorial

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Prehospital coronary care

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The Executive Board of the World Health Organization has stated (Stamler, 1973) that 'Coronary heart disease has reached enormous proportions, striking more and more at younger subjects. It will result in coming years in the greatest epidemic mankind has faced unless we are able to reverse the trend by concentrated research into its cause and prevention.' The logic of primary prevention is irrefutable but it appears unlikely that much progress will be made in this direction in the immediate future. Meanwhile, there are more than 55,000 deaths from acute myocardial infarction among individuals under the age of 70 in Great Britain each year. Coronary care units have reduced the hospital mortality from acute myocardial infarction. Unfortunately, more than two-thirds of the deaths occur before the patient has a chance of reaching hospital. Thus, 63 per cent of the deaths among men, aged 50 or less, occur within one hour (Bainton and Peterson, 1963). Among patients of both sexes under the age of 65 with an initial coronary attack 61 per cent of the deaths occur within that time (Gordon and Kannel, 1971). The median interval between the onset of symptoms and hospital admission may be more than 8 hours (McDonald, 1968; McNeilly and Pemberton, 1968). It is, therefore, clear that hospital coronary care units cannot affect significantly the community mortality from acute myocardial infarction.

More than 90 per cent of the early deaths result from ventricular fibrillation (Adgey *et al.*, 1969). Patients with mild infarction incur the same risk of ventricular fibrillation as those in whom the infarct is larger (Lawrie *et al.*, 1968). Thus, many, if not the majority, of these early deaths are unnecessary.

Since the major problem is outside hospital various prehospital schemes have been evolved.

The mobile coronary care unit (MCCU) was developed at the Royal Victoria Hospital in Belfast in 1966 (Pantridge and Geddes, 1966, 1967). Since the ambulance depot for the city is in the grounds of this hospital the MCCU is able to operate through the ordinary emergency system. No special vehicle is used, but initially 1, and now 2 of the 36 ambulances have been slightly modified. A different scheme was required for that part of the Belfast population located east of the river and remote from the ambulance depot (Barber *et al.*, 1970). Here, a mini-vehicle containing the necessary equipment, drugs, and intravenous solutions is on standby proximal to the coronary care unit of the district hospital. A junior doctor and nurse from the coronary care unit travel in the mini-vehicle. If the patient has a myocardial infarction an ambulance is summoned and one member of the team accompanies the patient to hospital, monitoring him on the way. The other member of the team drives the mini-vehicle back to base. Neither Belfast scheme necessitates the employment of additional ambulance drivers. Mobile coronary care duty in both schemes is added to the other duties of the hospital coronary care personnel. No individual is unemployed between calls.

Mobile coronary care units staffed by medical personnel have been developed elsewhere in Europe (W. Steinbrunn, 1973, personal communication; Lund, 1973; A. J. Dunning, 1973, personal communication), in the United States (Grace and Chadbourn, 1970; Crampton *et al.*, 1972), in Australia (Robinson and McLean, 1970; O'Rourke, 1972a), and in Japan (Miura, 1972). It has been shown that the correction of ventricular fibrillation outside hospital is a practical proposition (Pantridge and Geddes, 1967; Adgey *et al.*, 1969), and that deaths during transport may be eliminated (Pantridge, 1970c). In the absence of mobile coronary care, transport deaths account for a varying proportion of coronary deaths, depending on transport time and distance. An important feature of mobile coronary care is that patients may be admitted directly to the coronary care unit, thus avoiding the casualty department which may be in some hospitals

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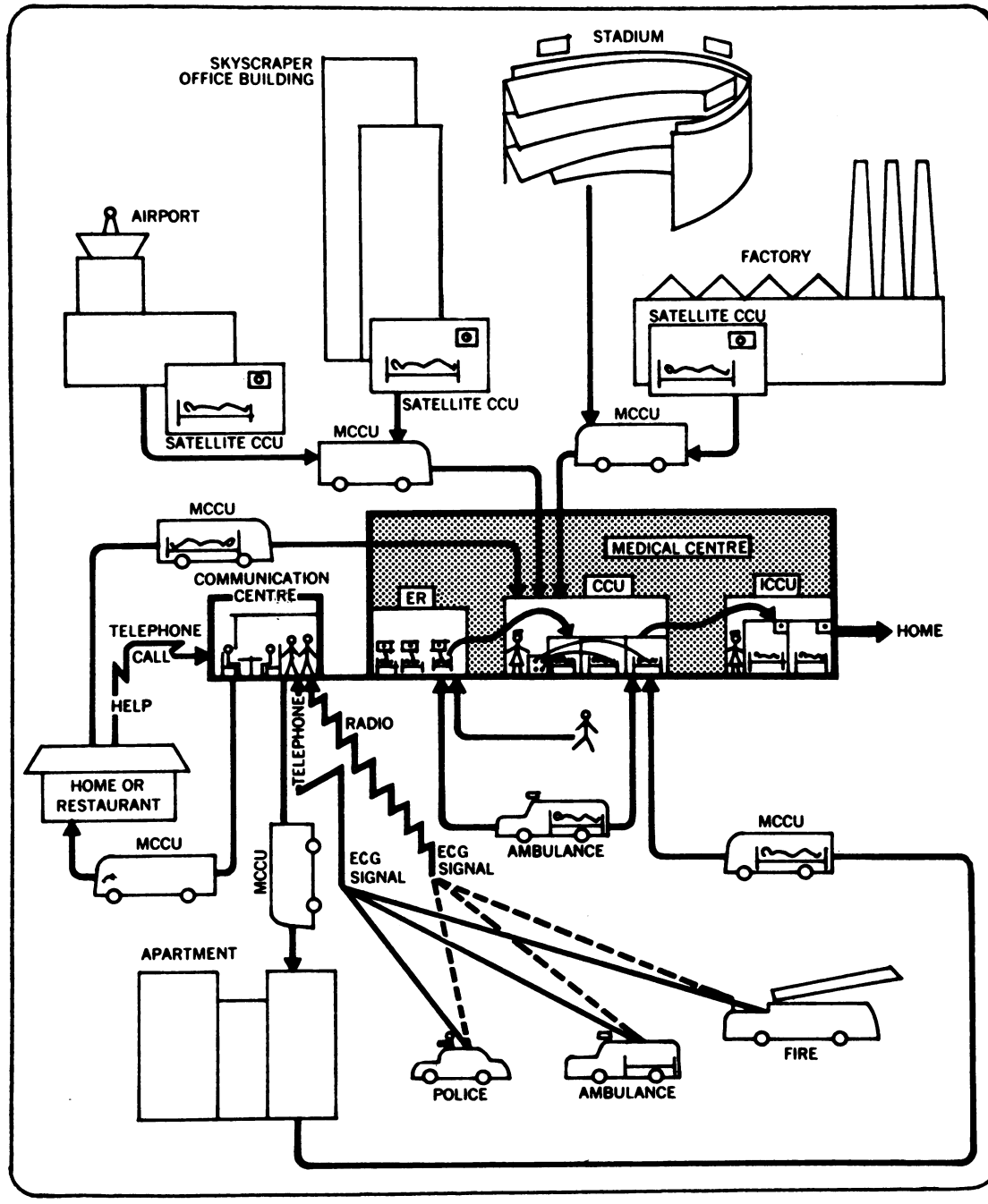

FIG. *Integrated static and mobile prehospital coronary care scheme, New York (Grace, 1973). MCCU, mobile coronary care unit; CCU, coronary care unit; ICCU, intermediate care unit; and ER, emergency room.*

the most dangerous place for a patient with acute myocardial infarction. It has been said that those who die in the casualty department or arrive dead account for 60 per cent of hospital deaths from the coronary attack (W. Somerville, 1970, personal communication).

Mobile coronary care units have made it possible to get a significant proportion of patients under intensive care early. Twenty-seven per cent may obtain intensive care within one hour (Adgey *et al.*, 1971) whereas only 2 per cent of those managed in the conventional way are admitted to hospital within that time (D. G. Julian, 1973, personal communication). The early initiation of intensive care and the prevention or correction of dysrhythmias and autonomic disturbances may halt the progressive increase in the area of infarction and thus diminish the incidence of shock and pump failure (Pantridge, 1970b). It has been found that the incidence of cardiogenic shock among those seen within 3 hours was less than 5 per cent whereas that among those seen after 3 hours was over 13 per cent. Hospital deaths among those who came under intensive care within 3 hours was less than 10 per cent whereas among those in whom intensive care was delayed the mortality was 19 per cent (Adgey *et al.*, 1971). That the magnitude of the area of infarction may be influenced by haemodynamic disturbance and pharmacological intervention has been confirmed in the experimental situation (Maroko *et al.*, 1971).

The operation of mobile coronary care units staffed by medical personnel has provided information regarding the autonomic disturbance which complicates acute myocardial infarction and information regarding the incidence of the early dysrhythmias (Webb, Adgey, and Pantridge, 1972). Bradycardia and ventricular dysrhythmias are frequent among those seen early (Pantridge *et al.*, 1973). The relation between bradycardia and ventricular fibrillation is still the subject of much discussion (Epstein *et al.*, 1973). There is, however, no disagreement about the relation between bradycardia and hypotension. The early bradycardia of acute myocardial infarction is usually complicated by hypotension which is frequently profound. Among the patients seen within 30 minutes, 22 per cent will have a systolic blood pressure not over 80 mmHg (Pantridge *et al.*, 1973). Thus, the suggestion (Yu, 1972; Paul, 1973) that the patient with acute myocardial infarction be advised to proceed as quickly as possible to the nearest hospital, is far from prudent. Clearly, the patient requires skilled management at the site of the attack. It has been shown that the relatively frequent early acute atrioventricular block will respond to atropine (Adgey *et al.*, 1968).

Although mobile coronary care units staffed by medical personnel now operate in many parts of the world, and though the high incidence of early preventable death from acute myocardial infarction is one of the major problems in medicine, relatively few mobile coronary care units operate in Great Britain. The reasons for this relate to misconceptions regarding the cost, to misinterpetation of the results of the South-Western study (Mather *et al.*, 1971), and to the reputed unavailability in some areas of medical personnel to staff such units. Undoubtedly the concept of mobile coronary care has been influenced adversely by the entirely erroneous assumption that large, specially equipped, and expensive vehicles and additional ambulance drivers are necessary. The MCCU may be integrated into the existing emergency system and the addition of a prehospital coronary care scheme to the hospital coronary care unit should result in only a marginal increase in the cost, apart from that increase resulting from the admission of those whose death outside hospital is prevented. This latter cost may be diminished when attention is directed to the earlier discharge of patients no longer at risk. It has been shown that one-third of patients with acute myocardial infarction may be discharged on the third day (Wilson and Pantridge, 1973). When a higher proportion of patients get intensive care early, fewer will have large infarcts and, therefore, more will qualify for early discharge.

No prehospital scheme will operate effectively without the co-operation of the general practitioner. It is, therefore, singularly unfortunate that doubt has been cast on the relevance of coronary care by misunderstanding of the findings of the South-Western study. This study purports to show that for some patients with acute myocardial infarction treatment at home may be satisfactory. Statisticians have found the design and the conduct of the trial far from satisfactory. Even if the findings of the study are accepted, the data indicate that the proportion of patients who may be left at home is very small. The South-Western study concerned men. It was assumed that for social reasons women with acute myocardial infarction would require admission to hospital. It was found that some 60 per cent of the men required 'elective' admission to hospital. The risk of ventricular fibrillation is greatest immediately after the onset of coronary occlusion (Pantridge and Geddes, 1967). Thus, patients who seek medical help early and certainly those seen within 4 hours will require admission to hospital. The South-Western data show that even in an area where doubt has been cast on the concept of coronary care more than 50 per cent of patients seek medical help within 4 hours. The South-Western study, there-

fore, indicates that some 85 per cent will require hospital admission if it is assumed that the ratio of men to women with acute infarction is 3:1. When a prehospital coronary care scheme exists more patients will seek help early and, therefore, a higher proportion will require admission to hospital.

There is no evidence whatever to support the suggestion that the arrival of a mobile team may precipitate ventricular dysrhythmias. Among those patients managed by a mobile unit who had ventricular fibrillation within one hour of the onset of symptoms 80 per cent had cardiac arrest before the arrival of the mobile team (Pantridge *et al.*, 1973) (Fig.).

The difficulty in obtaining medical personnel to staff mobile units need not prevent entirely the development of a prehospital coronary care scheme. It has been shown that paramedical personnel are capable of resuscitating patients from ventricular fibrillation (White *et al.*, 1973). In many parts of the United States mobile units are staffed by emergency medical technicians, some of whom are trained to 'near physician level'. In Los Angeles county there are 28 such units (A. J. Lewis, 1973, personal communication). The Seattle unit (Cobb and Alvarez, 1973) has had remarkable success. In the last year of its operation there have been 64 long-term survivors among patients resuscitated outside hospital. If this figure is applicable to the urban situation in Great Britain some 3000 lives might be saved annually from the correction of ventricular fibrillation outside hospital. While paramedical personnel have been shown to be capable of resuscitating patients from ventricular fibrillation, doubt exists as to whether they will be able to manage the dysrhythmias and autonomic disturbances frequently present in the acute phase of myocardial infarction. There is at present no procrustean approach to the correction of these difficulties. Careful titration of the dose of the necessary drugs is required. Since the dysrhythmias and the autonomic disturbance influence the magnitude of the infarct and, therefore, the incidence of shock, pump failure, and the long-term prognosis, there will continue to be a need for the operation of mobile coronary care units staffed by medical personnel. This will be particularly so if such personnel are oriented towards further elucidation of the problems of acute myocardial infarction and the development of a simplified therapeutic regimen for the stabilization of the rhythm, the autonomic difficulty, and the haemodynamic state. If such a regimen evolves it might be initiated not only by emergency technicians but also in some situations by the patient himself (Sarnoff, 1970). Highly efficient automatic injectors exist for the self-administration of drugs. The drugs to be carried in such syringes and the dosage are the problems to be solved.

Effective prehospital coronary care will demand public education directed towards reducing the delay between the onset of symptoms and the request for medical help. Publicity programmes aimed at shortening this interval are being evolved (Yu, 1972). Consideration is also being given to the provision of static prehospital coronary care units or 'life support stations' in situations where large numbers of individuals in the coronary age group congregate. It is suggested that such static units should exist in large industrial establishments, airports, and football stadiums (Carveth, 1968). An integrated static and mobile coronary care system has been implemented in part in one area in New York (Grace, 1973) (Fig.).

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